

108TH CONGRESS
1ST SESSION

S. 189

To authorize appropriations for nanoscience, nanoengineering, and nanotechnology research, and for other purposes.

IN THE SENATE OF THE UNITED STATES

JANUARY 16, 2003

Mr. WYDEN (for himself, Mr. ALLEN, Mr. LIEBERMAN, Mr. WARNER, Ms. MIKULSKI, Mr. HOLLINGS, Ms. LANDRIEU, Mrs. CLINTON, Mr. LEVIN, and Mr. BAYH) introduced the following bill; which was read twice and referred to the Committee on Commerce, Science, and Transportation

A BILL

To authorize appropriations for nanoscience, nanoengineering, and nanotechnology research, and for other purposes.

1 *Be it enacted by the Senate and House of Representa-*
2 *tives of the United States of America in Congress assembled,*

3 **SECTION 1. SHORT TITLE.**

4 This Act may be cited as the “21st Century
5 Nanotechnology Research and Development Act”.

6 **SEC. 2. FINDINGS.**

7 The Congress makes the following findings:

8 (1) The emerging fields of nanoscience and
9 nanoengineering (collectively, “nanotechnology”), in which

1 matter is manipulated at the atomic level (i.e., atom-by-
2 atom or molecule-by-molecule) in order to build materials,
3 machines, and devices with novel properties or functions,
4 are leading to unprecedented scientific and technological
5 opportunities that will benefit society by changing the way
6 many things are designed and made.

7 (2) Long-term nanoscale research and development
8 leading to potential breakthroughs in areas such as mate-
9 rials and manufacturing, electronics, medicine and
10 healthcare, environment, energy, chemicals, biotechnology,
11 agriculture, information technology, and national security
12 could be as significant as the combined influences of
13 microelectronics, biotechnology, and information tech-
14 nology on the 20th century. Nanotechnology could lead to
15 things such as—

16 (A) new generations of electronics where the en-
17 tire collection of the Library of Congress is stored
18 on devices the size of a sugar cube;

19 (B) manufacturing that requires less material,
20 pollutes less, and is embedded with sophisticated
21 sensors that will internally detect signs of weakness
22 and automatically respond by releasing chemicals
23 that will prevent damage;

1 (C) prosthetic and medical implants whose sur-
2 faces are molecularly designed to interact with the
3 cells of the body;

4 (D) materials with an unprecedented combina-
5 tion of strength, toughness, and lightness that will
6 enable land, sea, air, and space vehicles to become
7 lighter and more fuel efficient;

8 (E) selective membranes that can fish out spe-
9 cific toxic or valuable particles from industrial waste
10 or that can inexpensively desalinate sea water; and

11 (F) tiny robotic spacecraft that will cost less,
12 consume very little power, adapt to unexpected envi-
13 ronments, change its capabilities as needed, and be
14 completely autonomous.

15 (3) Long-term, high-risk research is necessary to cre-
16 ate breakthroughs in technology. Such research requires
17 government funding since the benefits are too distant or
18 uncertain for industry alone to support. Current Federal
19 investments in nanotechnology research and development
20 are not grounded in any specifically authorized statutory
21 foundation. As a result, there is a risk that future funding
22 for long-term, innovative research will be tentative and
23 subject to instability which could threaten to hinder future
24 United States technological and economic growth.

1 (4) The Federal government can play an important
2 role in the development of nanotechnology, as this science
3 is still in its infancy, and it will take many years of sus-
4 tained investment for this field to achieve maturity.

5 (5) Many foreign countries, companies and scientists
6 believe that nanotechnology will be the leading technology
7 of the 21st century and are investing heavily into its re-
8 search. According to a study of international
9 nanotechnology research efforts sponsored by the National
10 Science and Technology Council, the United States is at
11 risk of falling behind its international competitors, includ-
12 ing Japan, South Korea, and Europe if it fails to sustain
13 broad based funding in nanotechnology. The United
14 States cannot afford to fall behind our competitors if we
15 want to maintain our economic strength.

16 (6) Advances in nanotechnology stemming from Fed-
17 eral investments in fundamental research and subsequent
18 private sector development likely will create technologies
19 that support the work and improve the efficiency of the
20 Federal government, and contribute significantly to the ef-
21 forts of the government's mission agencies.

22 (7) According to various estimates, including those
23 of the National Science Foundation, the market for
24 nanotech products and services in the United States alone
25 could reach over \$1 trillion later this century.

1 (8) Nanotechnology will evolve from modern advances
2 in chemical, physical, biological, engineering, medical, and
3 materials research, and will contribute to cross-discipli-
4 nary training of the 21st century science and technology
5 workforce.

6 (9) Mastering nanotechnology will require a unique
7 skill set for scientists and engineers that combine chem-
8 istry, physics, material science, and information science.
9 Funding in these critical areas has been flat for many
10 years and as a result fewer young people are electing to
11 go into these areas in graduate schools throughout the
12 United States. This will have to reverse if we hope to de-
13 velop the next generation of skilled workers with multi-
14 disciplinary perspectives necessary for the development of
15 nanotechnology.

16 (10) Research on nanotechnology creates unprece-
17 dented capabilities to alter ourselves and our environment
18 and will give rise to a host of novel social, ethical, philo-
19 sophical, and legal issues. To appropriately address these
20 issues will require wide reflection and guidance that are
21 responsive to the realities of the science, as well as addi-
22 tional research to predict, understand, and alleviate antici-
23 pated problems.

24 (11) Nanotechnology will provide structures to enable
25 the revolutionary concept of quantum computing, which

1 uses quantum mechanical properties to do calculation.
2 Quantum computing permits a small number of atoms to
3 potentially store and process enormous amounts of infor-
4 mation. Just 300 interacting atoms in a quantum com-
5 puter could store as much information as a classical elec-
6 tronic computer that uses all the particles in the universe,
7 and today's complex encryption algorithms, which would
8 take today's best super computer 20 billion years, could
9 be cracked in 30 minutes.

10 (12) The Executive Branch has previously established
11 a National Nanotechnology Initiative to coordinate Fed-
12 eral nanotechnology research and development programs.
13 This initiative has contributed significantly to the develop-
14 ment of nanotechnology. Authorizing legislation can serve
15 to establish new technology goals and research directions,
16 improve agency coordination and oversight mechanisms,
17 help ensure optimal returns to investment, and simplify
18 reporting, budgeting, and planning processes for the Exec-
19 utive Branch and the Congress.

20 (13) The private sector technology innovations that
21 grow from fundamental nanotechnology research are de-
22 pendent on a haphazard, expensive, and generally ineffi-
23 cient technology transition path. Strategies for accel-
24 erating the transition of fundamental knowledge and inno-
25 vations in commercial products or to support mission

1 agencies should be explored, developed, and when appro-
2 priate, executed.

3 (14) Existing data on the societal, ethical, edu-
4 cational, legal, and workforce implications and issues re-
5 lated to nanotechnology are lacking. To help decision-mak-
6 ers and affected parties better anticipate issues likely to
7 arise with the onset and maturation of nanotechnology,
8 research and studies on these issues must be conducted
9 and disseminated.

10 (15) Many States and regions have begun
11 nanotechnology programs. These programs have developed
12 expertise, particularly with regard to providing infrastruc-
13 ture and preparing the nanotechnology workforce. The
14 Federal nanotechnology program should leverage these ex-
15 isting State and local institutions to best provide a coordi-
16 nated and comprehensive nanotechnology research port-
17 folio.

18 (16) In “Small Wonders, Endless Frontiers” the Na-
19 tional Academy of Sciences’ National Research Council
20 recommends increased investment in nanotechnology, par-
21 ticularly at the intersection of nanotechnology and biology.
22 Such investments will allow significant advancements in
23 biotechnology and medicine.

1 **SEC. 3. PURPOSE.**

2 It is the purpose of this Act to authorize a coordi-
3 nated inter-agency program that will support long-term
4 nanoscale research and development leading to potential
5 breakthroughs in areas such as materials and manufac-
6 turing, nanoelectronics, medicine and healthcare, environ-
7 ment, energy, chemicals, biotechnology, agriculture, infor-
8 mation technology, and national and homeland security.

9 **SEC. 4. NATIONAL NANOTECHNOLOGY RESEARCH PRO-**
10 **GRAM.**

11 (a) NATIONAL NANOTECHNOLOGY RESEARCH PRO-
12 GRAM.—The President shall establish a National
13 Nanotechnology Research Program. Through appropriate
14 agencies, councils, and the National Coordination Office,
15 the program shall—

16 (1) establish the goals, priorities, grand chal-
17 lenges, and metrics for evaluation for Federal
18 nanotechnology research, development, and other ac-
19 tivities;

20 (2) invest in Federal research and development
21 programs in nanotechnology and related sciences to
22 achieve those goals; and

23 (3) provide for interagency coordination of Fed-
24 eral nanotechnology research, development, and
25 other activities undertaken pursuant to the program.

1 (b) GOALS OF THE NATIONAL NANOTECHNOLOGY
2 RESEARCH PROGRAM.—The goals of the program are as
3 follows:

4 (1) The coordination of long-term fundamental
5 nanoscience and engineering research to build a fun-
6 damental understanding of matter enabling control
7 and manipulation at the nanoscale.

8 (2) The assurance of continued United States
9 global leadership in nanotechnology to meet national
10 goals and to support national economic, health, na-
11 tional security, educational, and scientific interests.

12 (3) The advancement of United States produc-
13 tivity and industrial competitiveness through stable,
14 consistent, and coordinated investments in long-term
15 scientific and engineering research in
16 nanotechnology.

17 (4) The development of a network of shared
18 academic facilities and technology centers, including
19 State supported centers, that will play a critical role
20 in accomplishing the other goals of the program, fos-
21 ter partnerships, and develop and utilize next gen-
22 eration scientific tools.

23 (5) The development of enabling infrastructural
24 technologies that United States industry can use to

1 commercialize new discoveries and innovations in
2 nanoscience.

3 (6) The acceleration of the deployment and
4 transition of advanced and experimental
5 nanotechnology and concepts into the private sector.

6 (7) The establishment of a program designed to
7 provide effective education and training for the next
8 generation of researchers and professionals skilled in
9 the multidisciplinary perspectives necessary for
10 nanotechnology.

11 (8) To ensure that philosophical, ethical, and
12 other societal concerns will be considered alongside
13 the development of nanotechnology.

14 (c) RESEARCH AND DEVELOPMENT AREAS.—
15 Through its participating agencies, the National
16 Nanotechnology Research Program shall develop, fund,
17 and manage Federal research programs in the following
18 areas:

19 (1) LONG-TERM FUNDAMENTAL RESEARCH.—
20 The program shall undertake long-term basic
21 nanoscience and engineering research that focuses
22 on fundamental understanding and synthesis of
23 nanometer-size building blocks with potential for
24 breakthroughs in areas such as materials and manu-
25 facturing, nanoelectronics, medicine and healthcare,

1 environment, energy, chemical and pharmaceuticals
2 industries, biotechnology and agriculture, computa-
3 tion and information technology, and national secu-
4 rity. Funds made available from the appropriate
5 agencies under this paragraph shall be used—

6 (A) to provide awards of less than
7 \$1,000,000 each to single investigators and
8 small groups to provide sustained support to in-
9 dividual investigators and small groups con-
10 ducting fundamental, innovative research; and

11 (B) to fund fundamental research and the
12 development of university-industry-laboratory
13 and interagency (including State-led) partner-
14 ships.

15 (2) GRAND CHALLENGES.—The program shall
16 support grand challenges that are essential for the
17 advancement of the field and interdisciplinary re-
18 search and education teams, including multidisci-
19 plinary nanotechnology research centers, that work
20 on major long-term objectives. This funding area will
21 fund, through participating agencies, interdiscipli-
22 nary research and education teams that aim to
23 achieve major, long-term objectives, such as the fol-
24 lowing:

1 (A) Nanomaterials by design which are
 2 stronger, lighter, harder, self-repairing, and
 3 safer.

4 (B) Nanoelectronics, optoelectronics, and
 5 magnetics.

6 (C) Healthcare applications.

7 (D) Nanoscale processes and environment.

8 (E) Energy and energy conservation.

9 (F) Microspacecraft.

10 (G) Bio-nanodevices for detection and miti-
 11 gation of biothreats to humans.

12 (H) Economical, efficient, and safe trans-
 13 portation.

14 (I) National and homeland security.

15 (J) Other appropriate challenges.

16 (3) INTERDISCIPLINARY NANOTECHNOLOGY RE-
 17 SEARCH CENTERS.—The Program, through the ap-
 18 propriate agencies, shall fund, on a competitive
 19 merit reviewed basis, research centers in the range
 20 of \$3,000,000 to \$5,000,000 per year each for 5
 21 years. A grant under this paragraph to a center may
 22 be renewed for 1 5-year term on the basis of that
 23 center's performance, determined after a review. The
 24 program, through its participating agencies, shall
 25 encourage research networking among centers and

1 researchers and require access to facilities to both
2 academia and industry. The centers shall assist in
3 reaching other initiative priorities, including funda-
4 mental research, grand challenges, education, devel-
5 opment and utilization of specific research tools, and
6 promoting partnerships with industry. To the great-
7 est extent possible, agencies participating in the pro-
8 gram shall establish geographically diverse centers
9 including at least one center in a State participating
10 in the National Science Foundation's (NSF) Experi-
11 mental Program, to Stimulate Competitive Research
12 (EPSCoR), established under section 113 of the
13 NSF Authorization Act of 1988 (42 U.S.C. 1862(g))
14 and shall encourage the participation of minority
15 serving institutions at these centers.

16 (4) RESEARCH INFRASTRUCTURE.—The pro-
17 gram, through its participating agencies, shall en-
18 sure adequate research infrastructure and equipment
19 for rapid progress on program goals, including the
20 employment of underutilized manufacturing facilities
21 in areas of high unemployment as production engi-
22 neering and research testbeds for micron-scale tech-
23 nologies. Major research equipment and instrumen-
24 tation shall be an eligible funding purpose under the
25 program.

1 (5) SOCIETAL, ETHICAL, EDUCATIONAL, LEGAL,
2 AND WORKFORCE ISSUES RELATED TO
3 NANOTECHNOLOGY.—The Director of the National
4 Science Foundation shall establish a new Center for
5 Societal, Ethical, Educational, Legal, and Workforce
6 Issues Related to Nanotechnology at \$5,000,000 per
7 year to encourage, conduct, coordinate, commission,
8 collect, and disseminate research on the societal, eth-
9 ical, educational, legal, and workforce issues related
10 to nanotechnology. The Center shall also conduct
11 studies and provide input and assistance to the Di-
12 rector of the National Science Foundation in com-
13 pleting the annual report required under paragraph
14 7(b)(3) of this Act.

15 (6) TRANSITION OF TECHNOLOGY.—The pro-
16 gram, through its participating agencies, shall en-
17 sure cooperation and collaboration with United
18 States industry in all relevant research efforts and
19 develop mechanisms to assure prompt technology
20 transition.

21 (7) GAP FUNDING.—The program shall address
22 research areas identified by the Council under sec-
23 tion 5(a)(9) of this Act through a program of com-
24 petitive grants to be awarded in such areas by the
25 Director of the National Science Foundation using

1 the Foundation's funds and any funds contributed
2 to the Foundation by other participating agencies
3 for this purpose. Such grants may be made to gov-
4 ernment or non-government awardees. Where appro-
5 priate, such grants may encourage interagency part-
6 nerships or leverage the expertise of State-supported
7 nanotechnology programs.

8 **SEC. 5. PROGRAM COORDINATION AND MANAGEMENT.**

9 (a) IN GENERAL.—The National Science and Tech-
10 nology Council shall oversee the planning, management,
11 and coordination of the Federal nanotechnology research
12 and development program. The Council, itself or through
13 an appropriate subgroup it designates or establishes,
14 shall—

15 (1) establish a set of broad applications of
16 nanotechnology research and development, or grand
17 challenges, to be met by the results and activities of
18 the program, based on national needs;

19 (2) submit to the Congress through the Senate
20 Committee on Commerce, Science, and Transpor-
21 tation, and the House of Representatives Committee
22 on Science, an annual report, along with the Presi-
23 dent's annual budget request, describing the imple-
24 mentation of the program under section 4;

1 (3) provide for interagency coordination of the
2 program, including with the Department of Defense;

3 (4) coordinate the budget requests of each of
4 the agencies involved in the program with the Office
5 of Management and Budget to ensure that a bal-
6 anced research portfolio is maintained in order to
7 ensure the appropriate level of research effort;

8 (5) provide guidance each year to the partici-
9 pating departments and agencies concerning the
10 preparation of appropriations requests for activities
11 related to the program;

12 (6) consult with academic, industry, State and
13 local government (including State and regional
14 nanotechnology programs), and other appropriate
15 groups conducting research on and using
16 nanotechnology;

17 (7) establish an Information Services and Ap-
18 plications Council to promote access to and early ap-
19 plication of the technologies, innovations, and exper-
20 tise derived from nanotechnology research and devel-
21 opment program activities to agency missions and
22 systems across the Federal government, and to
23 United States industry;

24 (8) in cooperation with the Advisory Panel es-
25 tablished under subsection (b), develop and apply

1 measurements using appropriate metrics for evalu-
2 ating program performance and progress toward
3 goals; and

4 (9) identify research areas which are not being
5 adequately addressed by the agencies' current re-
6 search programs.

7 (b) PRESIDENT'S NANOTECHNOLOGY ADVISORY
8 PANEL.—

9 (1) ESTABLISHMENT.—The President shall es-
10 tablish a National Nanotechnology Advisory Panel.

11 (2) SELECTION PROCEDURES.—The President
12 shall establish procedures for the selection of individ-
13 uals not employed by the Federal government who
14 are qualified in the science of nanotechnology and
15 other appropriate fields and may, pursuant to such
16 procedures, select up to 20 individuals, one of whom
17 shall be designated Chairman, to serve on the Advi-
18 sory Panel. Selection of individuals for the Advisory
19 Panel shall be based solely on established records of
20 distinguished fundamental and applied scientific
21 service, and the panel shall contain a reasonable
22 cross-section of views and expertise, including those
23 regarding the societal, ethical, educational, legal,
24 and workforce issues related to nanotechnology. In
25 selecting individuals to serve on the Advisory Panel,

1 the President shall seek and give due consideration
2 to recommendations from the Congress, industry,
3 the scientific community (including the National
4 Academy of Sciences), scientific professional soci-
5 eties, academia, the defense community, the edu-
6 cation community, State and local governments, and
7 other appropriate organizations.

8 (3) MEETINGS.—The Advisory Panel shall meet
9 no less than twice annually, at such times and places
10 as may be designated by the Chairman in consulta-
11 tion with the National Nanotechnology Coordination
12 Office established under subsection 5(c) of this Act.

13 (4) DUTIES.—The Advisory Panel shall advise
14 the President and the National Science and Tech-
15 nology Council, and inform the Congress, on matters
16 relating to the National Nanotechnology Program,
17 including goals, roles, and objectives within the pro-
18 gram, its capabilities and research needs, guidance
19 on achieving major objectives, and establishing and
20 measuring performance goals using appropriate
21 metrics. The Advisory Panel shall issue an annual
22 report, containing the information required by sub-
23 section (d) of this section, to the President, the
24 Council, the heads of each agency involved in the
25 program, the Senate Committee on Commerce,

1 Science, and Transportation, and the House of Rep-
 2 resentatives Committee on Science, on or before Sep-
 3 tember 30 of each year.

4 (c) NATIONAL NANOTECHNOLOGY COORDINATION
 5 OFFICE.—The President shall establish a National
 6 Nanotechnology Coordination Office, with full-time staff,
 7 to provide day-to-day technical and administrative support
 8 to the Council and the Advisory Panel, and to be the point
 9 of contact on Federal nanotechnology activities for govern-
 10 ment organizations, academia, industry, professional soci-
 11 eties, State nanotechnology programs, and others to ex-
 12 change technical and programmatic information. The Of-
 13 fice shall promote full coordination of research efforts be-
 14 tween agencies, scientific disciplines, and United States in-
 15 dustry.

16 (d) PROGRAM PLANS AND REPORTS.—

17 (1) ANNUAL EVALUATION OF NANOTECHNOL-
 18 OGY RESEARCH DEVELOPMENT PROGRAM.—The re-
 19 port by the Advisory Panel, required pursuant to
 20 subsection (b)(4), shall include—

21 (A) a review of the program’s technical
 22 success in achieving the stated goals and grand
 23 challenges according to the metrics established
 24 by the program and Advisory Panel;

1 (B) a review of the program's management
2 and coordination;

3 (C) a review of the funding levels by each
4 agency for the program's activities and their
5 ability to achieve the program's stated goals
6 and grand challenges;

7 (D) a review of the balance in the pro-
8 gram's portfolio and components across agen-
9 cies and disciplines;

10 (E) an assessment of the degree of partici-
11 pation in the program by minority serving insti-
12 tutions and institutions located in States par-
13 ticipating in NSF's EPSCoR program;

14 (F) a review of policy issues resulting from
15 advancements in nanotechnology and its effects
16 on the scientific enterprise, commerce, work-
17 force, competitiveness, national security, medi-
18 cine, and government operations;

19 (G) recommendations for new program
20 goals and grand challenges;

21 (H) recommendations for new research
22 areas, partnerships, coordination and manage-
23 ment mechanisms, or programs to be estab-
24 lished to achieve the program's stated goals and
25 grand challenges;

1 (I) recommendations for new investments
2 by each participating agency in each program
3 funding area for the 5-year period following the
4 delivery of the report;

5 (J) reviews and recommendations regard-
6 ing other issues deemed pertinent or specified
7 by the panel; and

8 (K) a technology transition study which in-
9 cludes an evaluation of the Federal
10 nanotechnology research and development pro-
11 gram's success in transitioning its research,
12 technologies, and concepts into commercial and
13 military products, including—

14 (i) examples of successful transition of
15 research, technologies, and concepts from
16 the Federal nanotechnology research and
17 development program into commercial and
18 military products;

19 (ii) best practices of universities, gov-
20 ernment, and industry in promoting effi-
21 cient and rapid technology transition in the
22 nanotechnology sector;

23 (iii) barriers to efficient technology
24 transition in the nanotechnology sector, in-
25 cluding, but not limited to, standards, pace

1 of technological change, qualification and
2 testing of research products, intellectual
3 property issues, and Federal funding; and
4 (iv) recommendations for government
5 sponsored activities to promote rapid tech-
6 nology transition in the nanotechnology
7 sector.

8 (2) OFFICE OF MANAGEMENT AND BUDGET RE-
9 VIEW.—

10 (A) BUDGET REQUEST REVIEW.—Each
11 Federal agency and department participating in
12 the program shall, as part of its annual request
13 for appropriations, submit information to the
14 Office of Management and Budget including—

15 (i) each element of its nanotechnology
16 research and development activities that
17 contributes directly to the program or ben-
18 efits from the program;

19 (ii) the portion of its request for ap-
20 propriations that is allocated to each such
21 element; and

22 (iii) the portion of its request for ap-
23 propriations that is allocated to each pro-
24 gram funding area.

1 (B) OMB REVIEW AND ALLOCATION
 2 STATEMENT.—The Office of Management and
 3 Budget shall review the information provided
 4 under subparagraph (A) in light of the goals,
 5 priorities, grand challenges, and agency and de-
 6 partmental responsibilities set forth in the an-
 7 nual report of the Council under paragraph (3),
 8 and shall include in the President’s annual
 9 budget estimate, a statement delineating the
 10 amount and portion of each appropriate agen-
 11 cy’s or department’s annual budget estimate re-
 12 lating to its activities undertaken pursuant to
 13 the program.

14 (3) ANNUAL NSTC REPORT TO CONGRESS ON
 15 THE NANOTECHNOLOGY RESEARCH DEVELOPMENT
 16 PROGRAM.—The National Science and Technology
 17 Council shall submit an annual report to the Con-
 18 gress that—

19 (A) includes a detailed description of the
 20 goals, grand challenges, and program funding
 21 areas established by the President for the pro-
 22 gram;

23 (B) sets forth the relevant programs and
 24 activities, for the fiscal year with respect to
 25 which the budget submission applies, of each

1 Federal agency and department, participating
2 in the program, as well as such other agencies
3 and departments as the President or the Direc-
4 tor considers appropriate;

5 (C) describes the levels of Federal funding
6 for the fiscal year during which such report is
7 submitted, and the levels proposed for the fiscal
8 year with respect to which the budget submis-
9 sion applies, for each of the program funding
10 areas of the program;

11 (D) describes the levels of Federal funding
12 for each agency and department participating
13 in the program and each program funding area
14 for the fiscal year during which such report is
15 submitted, and the levels proposed for the fiscal
16 year with respect to which the budget submis-
17 sion applies, and compare these levels to the
18 most recent recommendations of the Advisory
19 Panel and the external review of the program;

20 (E) describes coordination and partnership
21 activities with State, local, international, and
22 private sector efforts in nanotechnology re-
23 search and development, and how they support
24 the goals of the program;

1 (F) describes mechanisms and efforts used
2 by the program to assist in the transition of in-
3 novative concepts and technologies from Feder-
4 ally funded programs into the commercial sec-
5 tor, and successes in these transition activities;

6 (G) describes coordination between the
7 military and civilian portions, as well as the life
8 science and non-life science portions, of the pro-
9 gram in technology development, supporting the
10 goals of the program, and supporting the mis-
11 sion needs of the departments and agencies in-
12 volved;

13 (H) analyzes the progress made toward
14 achieving the goals, priorities, and grand chal-
15 lenges designated for the program according to
16 the metrics established by the program and the
17 Advisory Panel; and

18 (I) recommends new mechanisms of coordi-
19 nation, program funding areas, partnerships, or
20 activities necessary to achieve the goals, prior-
21 ities, and grand challenges established for the
22 program.

23 (4) TRIENNIAL EXTERNAL REVIEW OF
24 NANOTECHNOLOGY RESEARCH AND DEVELOPMENT
25 PROGRAM.—

1 (A) IN GENERAL.—The Director of the
2 National Science Foundation shall enter into an
3 arrangement with the National Research Coun-
4 cil of the National Academy of Sciences to con-
5 duct a triennial evaluation of the Federal
6 nanotechnology research and development pro-
7 gram, including—

8 (i) a review of the technical success of
9 the program in achieving the stated goals
10 and grand challenges under the metrics es-
11 tablished by the program and the
12 nanotechnology Advisory Panel, and under
13 other appropriate measurements;

14 (ii) a review of the program’s manage-
15 ment and coordination across agencies and
16 disciplines;

17 (iii) a review of the funding levels by
18 each agency for the program’s activities
19 and their ability with such funding to
20 achieve the program’s stated goals and
21 grand challenges;

22 (iv) recommendations for new or re-
23 vised program goals and grand challenges;

24 (v) recommendations for new research
25 areas, partnerships, coordination and man-

1 agement mechanisms, or programs to be
2 established to achieve the program's stated
3 goals and grand challenges;

4 (vi) recommendations for investment
5 levels in light of goals by each partici-
6 pating agency in each program funding
7 area for the 5-year period following the de-
8 livery of the report;

9 (vii) recommendations on policy, pro-
10 gram, and budget changes with respect to
11 nanotechnology research and development
12 activities;

13 (viii) recommendations for improved
14 metrics to evaluate the success of the pro-
15 gram in accomplishing its stated goals;

16 (ix) a review of the performance of
17 the Information Services and Applications
18 Council and its efforts to promote access
19 to and early application of the tech-
20 nologies, innovations, and expertise derived
21 from program activities to agency missions
22 and systems across the Federal govern-
23 ment and to United States industry; and

24 (x) an analysis of the relative position
25 of the United States compared to other na-

tions with respect to nanotechnology research and development, including the identification of any critical research areas where the United States should be the world leader to best achieve the goals of the program.

(B) EVALUATION TO BE TRANSMITTED TO CONGRESS.—The Director of the National Science Foundation shall transmit the results of any evaluation for which it made arrangements under subparagraph (A) to the Senate Committee on Commerce, Science, and Transportation and the House of Representatives Committee on Science upon receipt. The first such evaluation shall be transmitted no later than June 10, 2005, with subsequent evaluations transmitted to the Committees every 3 years thereafter.

SEC. 6. AUTHORIZATION OF APPROPRIATIONS.

(a) NATIONAL SCIENCE FOUNDATION.—

(1) GENERAL AUTHORIZATION.—There are authorized to be appropriated to the Director of the National Science Foundation to carry out the Director's responsibilities under this Act \$346,150,000 for fiscal year 2004.

1 (2) SPECIFIC ALLOCATIONS.—

2 (A) INTERDISCIPLINARY NANOTECHNOL-
3 OGY RESEARCH CENTERS.—Of the amounts de-
4 scribed in paragraph (1), \$50,000,000 for fiscal
5 year 2004, shall be available for grants of up to
6 \$5,000,000 each for multidisciplinary
7 nanotechnology research centers.

8 (B) CENTER FOR SOCIETAL, ETHICAL,
9 EDUCATIONAL, LEGAL, AND WORKFORCE
10 ISSUES RELATED TO NANOTECHNOLOGY.—Of
11 the sums authorized for the National Science
12 Foundation each fiscal year, \$5,000,000 shall
13 be used to establish a university-based Center
14 for Societal, Ethical, Educational, Legal, and
15 Workforce Issues Related to Nanotechnology.

16 (C) NATIONAL NANOTECHNOLOGY COORDI-
17 NATION OFFICE.—Of the sums authorized for
18 the National Science Foundation each fiscal
19 year, \$5,000,000 shall be used for the activities
20 of the Nanotechnology Coordination Office.

21 (D) GAP FUNDING.—Of the sums author-
22 ized for the National Science Foundation each
23 fiscal year, \$5,000,000 shall be for use in com-
24 petitive grants as described in section 4(c)(7) of
25 this Act.

1 (b) DEPARTMENT OF ENERGY.—There are author-
2 ized to be appropriated to the Secretary of Energy to carry
3 out the Secretary's responsibilities under this Act
4 \$160,195,000 for fiscal year 2004.

5 (c) NATIONAL AERONAUTICS AND SPACE ADMINIS-
6 TRATION.—There are authorized to be appropriated to the
7 Administrator of the National Aeronautics and Space Ad-
8 ministration to carry out the Administrator's responsibil-
9 ities under this Act \$58,650,000 for fiscal year 2004.

10 (d) NATIONAL INSTITUTES OF HEALTH.—There are
11 authorized to be appropriated to the Director of the Na-
12 tional Institutes to carry out the Director's responsibilities
13 under this Act \$49,680,000 for fiscal year 2004.

14 (e) NATIONAL INSTITUTE OF STANDARDS AND
15 TECHNOLOGY.—There are authorized to be appropriated
16 to the Director of the National Institute of Standards and
17 Technology to carry out the Director's responsibilities
18 under this Act \$50,600,000 for fiscal year 2004.

19 (f) ENVIRONMENTAL PROTECTION AGENCY.—There
20 are authorized to be appropriated to the Administrator of
21 the Environmental Protection Agency to carry out the Ad-
22 ministrator's responsibilities under this Act \$5,750,000
23 for fiscal year 2004.

24 (g) DEPARTMENT OF JUSTICE.—There are author-
25 ized to be appropriated to the Director of the National

1 Institute of Justice to carry out the Director's responsibil-
 2 ities under this Act \$1,610,000 for fiscal year 2004.

3 (h) DEPARTMENT OF TRANSPORTATION.—There are
 4 authorized to be appropriated to the Secretary of Trans-
 5 portation to carry out the Secretary's responsibilities
 6 under this Act \$2,300,000 for fiscal year 2004.

7 (i) DEPARTMENT OF AGRICULTURE.—There are au-
 8 thorized to be appropriated to the Secretary of Agriculture
 9 to carry out the Secretary's responsibilities under this Act
 10 \$2,870,000 for fiscal year 2004.

11 **SEC. 7. SOCIETAL, ETHICAL, EDUCATIONAL, LEGAL, AND**
 12 **WORKFORCE ISSUES RELATED TO**
 13 **NANOTECHNOLOGY.**

14 (a) STUDIES.—The Director of the National Science
 15 Foundation shall encourage, conduct, coordinate, commis-
 16 sion, collect, and disseminate studies on the societal, eth-
 17 ical, educational, and workforce implications of
 18 nanotechnology through the Center for Societal, Ethical,
 19 Educational, Legal, and Workforce Issues established
 20 under section 4(c)(5). The studies shall identify antici-
 21 pated issues and problems, as well as provide rec-
 22 ommendations for preventing or addressing such issues
 23 and problems.

24 (b) DATA COLLECTION.—The Director of the Na-
 25 tional Science Foundation shall collect data on the size

1 of the anticipated nanotechnology workforce need by de-
 2 tailed occupation, industry, and firm characteristics, and
 3 assess the adequacy of the trained talent pool in the
 4 United States to fill such workforce needs.

5 (c) ANNUAL REPORT.—The Director of the National
 6 Science Foundation shall compile the studies required by
 7 paragraph (2) and, with the assistance of the Center for
 8 Societal, Ethical, Educational, Legal, and Workforce
 9 Issues Related to Nanotechnology established under sec-
 10 tion 4(c)(5) of this Act, shall complete a report that in-
 11 cludes a description of the Center’s activities, which shall
 12 be submitted to the President, the Council, the Senate
 13 Committee on Commerce, Science, and Transportation,
 14 and the House of Representatives Committee on Science
 15 not later than 18 months after the date of enactment of
 16 this Act.

17 **SEC. 8. DEFINITIONS.**

18 In this Act:

19 (1) ADVISORY PANEL.—The term “Advisory
 20 Panel” means the President’s National
 21 Nanotechnology Panel.

22 (2) FUNDAMENTAL RESEARCH.—The term
 23 “fundamental research” means research that builds
 24 a fundamental understanding and leads to discov-
 25 eries of the phenomena, processes, and tools nec-

1 essary to control and manipulate matter at the
2 nanoscale.

3 (3) GRAND CHALLENGE.—The term “grand
4 challenge” means a fundamental problem in science
5 or engineering, with broad economic and scientific
6 impact, whose solution will require the application of
7 nanotechnology.

8 (4) INTERDISCIPLINARY NANOTECHNOLOGY RE-
9 SEARCH CENTER.—The term “interdisciplinary
10 nanotechnology research center” means a group of 6
11 or more researchers collaborating across scientific
12 and engineering disciplines on large-scale long-term
13 research projects that will significantly advance the
14 science supporting the development of
15 nanotechnology or the use of nanotechnology in ad-
16 dressing scientific issues of national importance,
17 consistent with the goals set forth in section 4(b).

18 (5) NANOTECHNOLOGY.—The term
19 “nanotechnology” means the ability to work at the
20 molecular level, atom-by-atom, to create large struc-
21 tures with fundamentally new molecular organiza-
22 tion.

23 (6) PROGRAM.—The term “program” means
24 the national nanotechnology research program estab-
25 lished under section 4.

1 (7) RESEARCH INFRASTRUCTURE.—The term
2 “research infrastructure” means the measurement
3 science, instrumentation, modeling and simulation,
4 and user facilities needed to develop a flexible and
5 enabling infrastructure so that United States indus-
6 try can rapidly commercialize new discoveries in
7 nanotechnology.

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